Future Communications Study

Communications Operating Concept and Requirements (COCR)

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Historical

- **Three phased approach supporting AP-17.**
  - Develop Initial COCR to support Technology Pre-Screening & Down Select.
    - Literature search for 2015 – 2030 Operating Concepts
    - Understand/Define/Describe Services
    - Establish Traffic Characteristics & Loading
    - Public Release April 2005
  - Develop COCR V1.0 to support Technology Selection.
    - Continued refinement of Initial COCR
    - Increase validity of requirements by modeling
    - Conduct Preliminary Safety, Security, Performance Analyses
    - Public Release March 6, 2006
  - Develop Final COCR V2.0 to support Technology Recommendations.
    - Validate concept & services w/stakeholders
    - Conduct Final Safety, Security, Performance Analyses
    - Public Release May 2007
- **Documents available on the following website**
  - http://www.nas-architecture.faa.gov/nas5/downloads/home.cfm

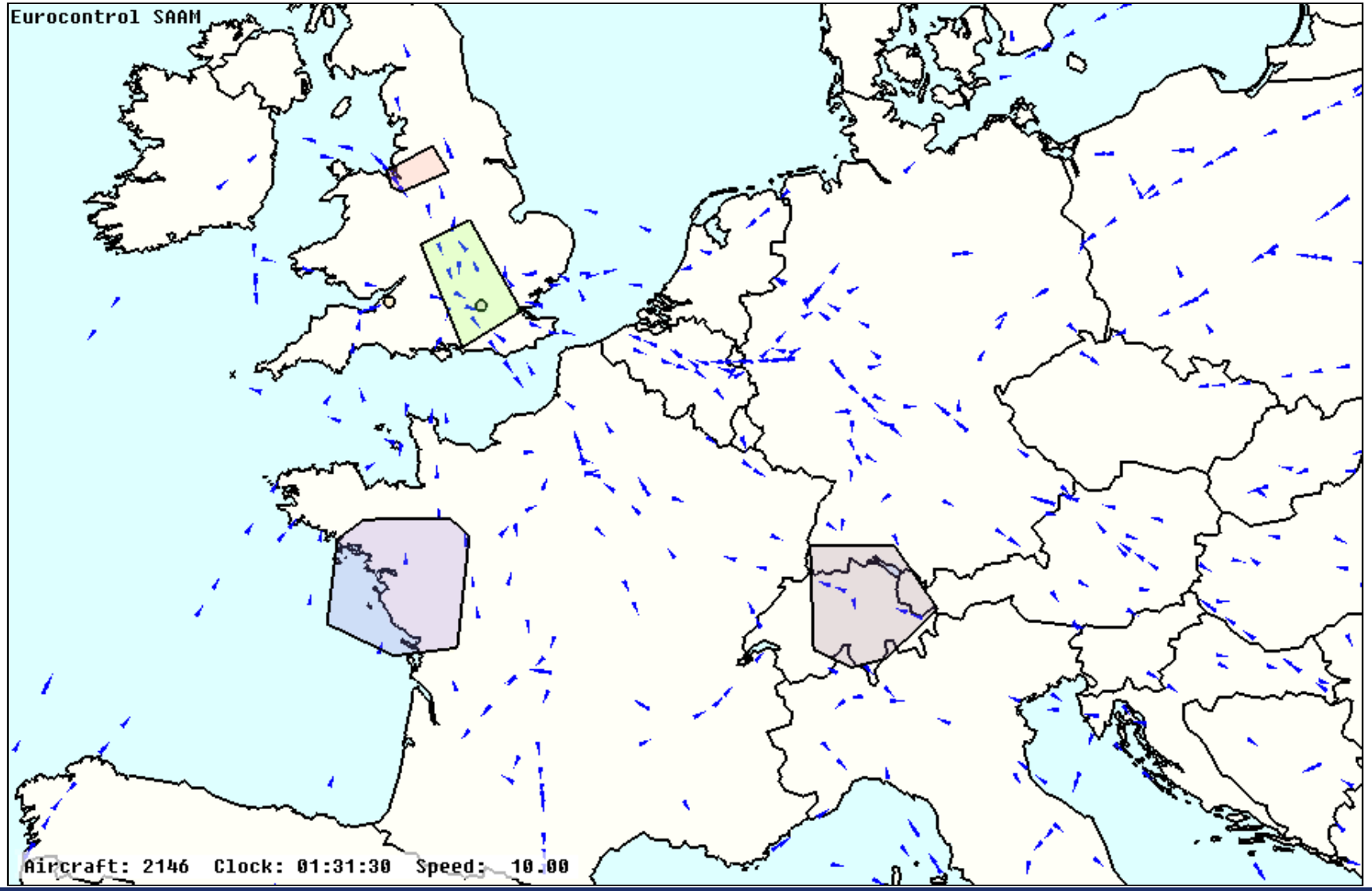
COCR Process

- **To develop the COCR, a seven step process was employed.**
  - Initially, to determine the overall context for future communications, numerous Concepts of Operations, Vision Statements and Plans being developed and circulated by ANSP's around the world were reviewed. Step 1 was complete when a notional vision and universal operating concept for air traffic management were developed.
  - In Step 2, identification and definition of ATS and AOC services necessary to achieve the vision.
  - In Step 3, the operating environment and scenarios in which these services would be provided was defined to ensure implications of each service were addressed.

COCR Process

- **Seven step process to develop the COCR (con't).**
  - Step 4 consisted of safety and security assessments for the air traffic services, which enabled;
  - Step 5's establishment of high-level requirements each service would have to meet and allocation of those requirements to the Future Radio System.
  - In Step 6, the capacity rates the FRS would have to handle in order to deliver the services was calculated.
  - By walking through a few sample applications of the previous results, the 7th and final Step attempted to put the COCR effort into perspective and facilitate future use.

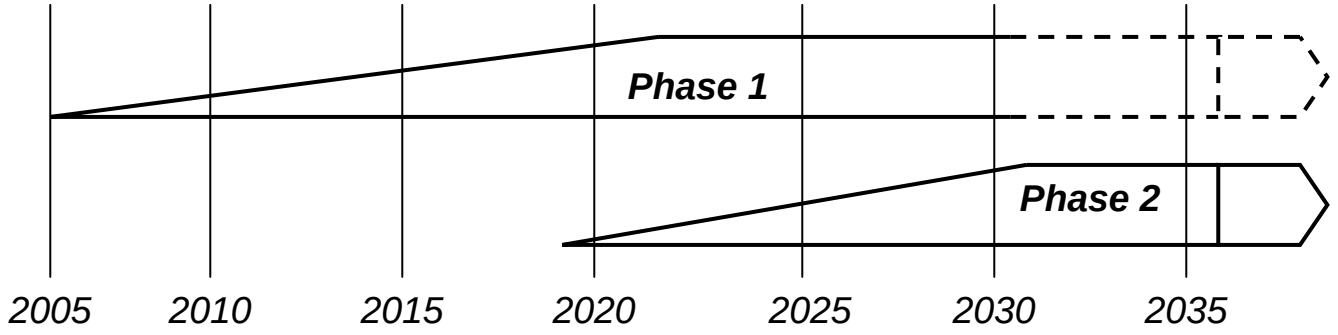
COCR Content Overview - A Day in 2025



COCR Content Overview

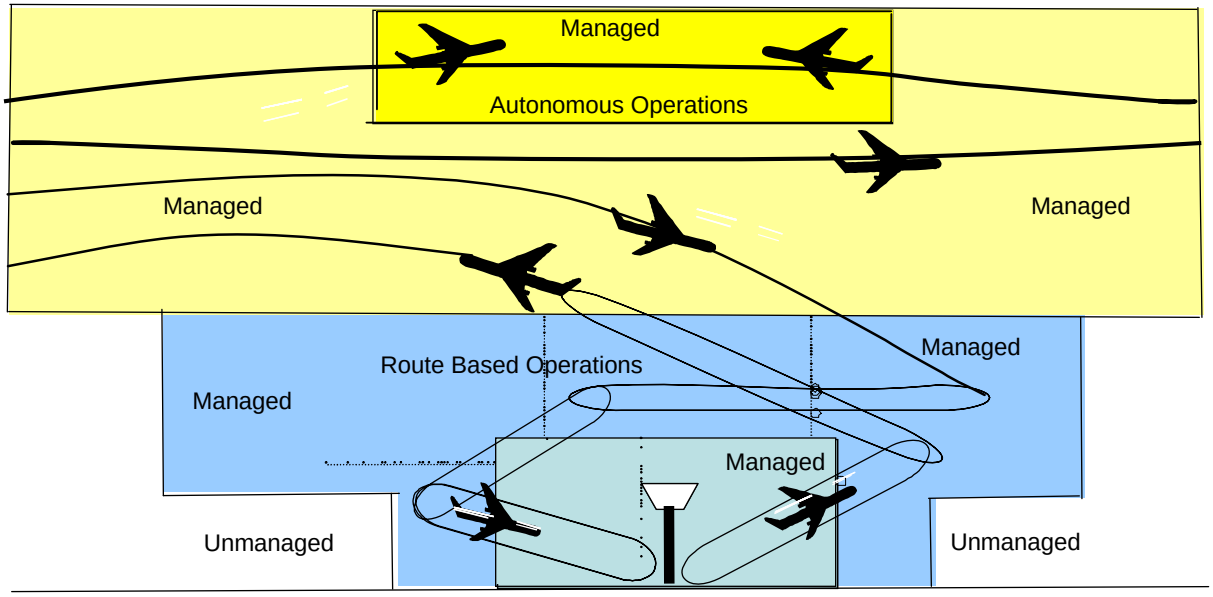
Operational Concept = Two Phases

- **Phase 1 beginning now, maturing ~2020.**
  - **Evolution of communications services from voice to data.**
  - **Operations begin the "paradigm shift" from "Management by Intervention" to "Management by Planning & Intervention by Exception".**
- **Phase 2 takes over to 2030 & beyond.**
  - **Evolution of communications services to support 4-D Trajectory Based Ops.**
  - **Autonomous Operations in designated airspace.**
  - **Air Traffic is Managed vs. Controlled.**
  - **Net Centric Operations allow air-ground flow of system wide information.**



COCR Content Overview

- **Two types of airspace exist in Phase 2:**
  - Unmanaged Airspace: VFR uncontrolled airspace/airports included in this category.
  - Managed Airspace:
    - **Traditional ATC, trajectory based ops, & instances of delegated separation & sequencing for limited duration**
    - **Autonomous airspace w/control exhibited upon entry/exit, but while inside users on own for conflict detection & resolution**



COCR Summary

- **Key points in the ATS concept considered include:**
  - ASAS Operations are implemented in some airspace
    - Beginning in Phase 1.
    - Leads to Autonomous Operations in Phase 2.
  - Larger sectors were assumed in Phase 2
    - Become more dynamic/flexible to meet traffic needs vs. airspace boundary needs.
  - Air Traffic Management begins using 4-D trajectory - based operations in managed airspace.
  - Automation exchanges become the norm for both ground and air
    - Enables longer range conflict prediction & resolution.
  - "Machine-to-Machine" information exchanges replace many Human-to-Human exchanges
  - The controller's role is transformed to a management paradigm through various decision support tools

COCR Summary

- **Key Points in the definition of the operational services include:**
  - Some services can only be effectively delivered by data
    - **Those that have extensive or complicated data streams, such as 4-D trajectories.**
  - Some services may only be effectively administered by voice
    - **Such as tactical communications requiring near-immediate reaction.**
  - Many services may be delivered by either means
    - **Workload or communications resource costs may be deciding factors of which media to use.**
  - Some services e.g., Automatic Execution may require alternate means
    - **While infrequently used, their availability may be required nonetheless.**

COCR Summary

- **Key points of the Safety Assessment include:**
  - Completed detailed safety, security and performance analyses for each service.
    - **Segregated into 8 “buckets” based on similarities**
  - The primary effect of the safety assessment was on parameters such as availability and integrity in the Phase 2 timeframe.
  - In an environment where standards are reduced to “encounter-specific” separation, ground &/or airborne systems must have the capability to detect conflicts, provide resolutions, and in rare cases implement the resolutions without human intervention.

COCR Summary

- **Key Findings of the Information Security Analysis include:**
  - **The security requirements were undertaken on an end-to-end basis**
    - Many of the security requirements are beyond the scope of the FRS.
  - **One security requirement that is directly relevant to the FRS**
    - Need for some level of deliberate RF interference resistance.
  - **The FRS should have the ability to use message security features**
    - Message authentication, as needed to ensure delivery of services that require high integrity messaging.

COCR Summary

- **Overall**
  - **In terms of capacity, future ATS air/ground data requirements appear to be relatively modest.**
    - Problem has more than one dimension as delivery of ATS requires simultaneous achievement of many, often challenging, requirements.
  - **ATS requires safety-driven combination**
    - Capacity, integrity, reliability, latency and coverage requirements typically dictate unique solutions for aviation.

COCR Summary

- **Overall (Con't)**
  - **Phase 2 requirements appear to be beyond the capabilities of systems currently deployed**
    - Numerous advanced technologies, as well as options for further evolution of today's most capable systems, should meet all but the most demanding services.
  - **Careful examination of the services will be necessary to balance costs and benefits**
    - Those that drive requirements.
      - **Are they worth the extra cost???**
    - What do they do to the associated business case???

COCR V1.0 to V2.0 Change Summary

- **Changes included:**
  - Introduction of an Executive Summary
  - Expansion in the definition of data link services – Section 2
  - Minor revision to the Operational Concepts taking into account the latest information from regional implementation planning – Section 3
  - More comprehensive safety assessment – Section 4
    - Itemized safety requirements for each service are contained in the Operational Services and Environment Definition reference document
  - Refinement of the performance requirements in light of the safety assessment – Section 5

COCR V1.0 to V2.0 Change Summary

- **Change Summary (Con't):**
  - Modification to the queuing model to produce the capacity requirements – Section 6
  - Moving former Section 7 to an Appendix
    - Example of real world use of the information
  - Correction of typographical errors
- **None of these changes resulted in a significant difference in the overall capacity results.**
  - Individual service changes up 1600% from V1.0
  - Large changes in small values net small affect

Questions?